



# GRAYWATER CURRICULUM

CLASS SIX

Beyond Laundry to Landscape

# Beyond Laundry to Landscape

## Gravity Fed Shower/Sink Systems

Graywater drains through a series of **branching pipes** and is dispersed into the landscape. This system alters the existing plumbing and **requires a permit**.

### Graywater Source:

- shower drains
- sinks

Slope is a key factor, gravity fed system

# Objectives

## **Branched Drain Inside Portion**

Step 1: Pipe identification

Step 2: Obtain a permit

Step 3: Installing a 3-way valve

Step 4: Optional: installing an actuator

## **Branched Drain Outdoor Portion**

Step 5: Branched Drain design

Step 6: Piping to irrigation field

Step 7: Calculate and dig mulch basins, build mulch shields

Step 8: Lay pipes to mulch basins

Step 9: Install Double Ells

# Parts for Branched Drain

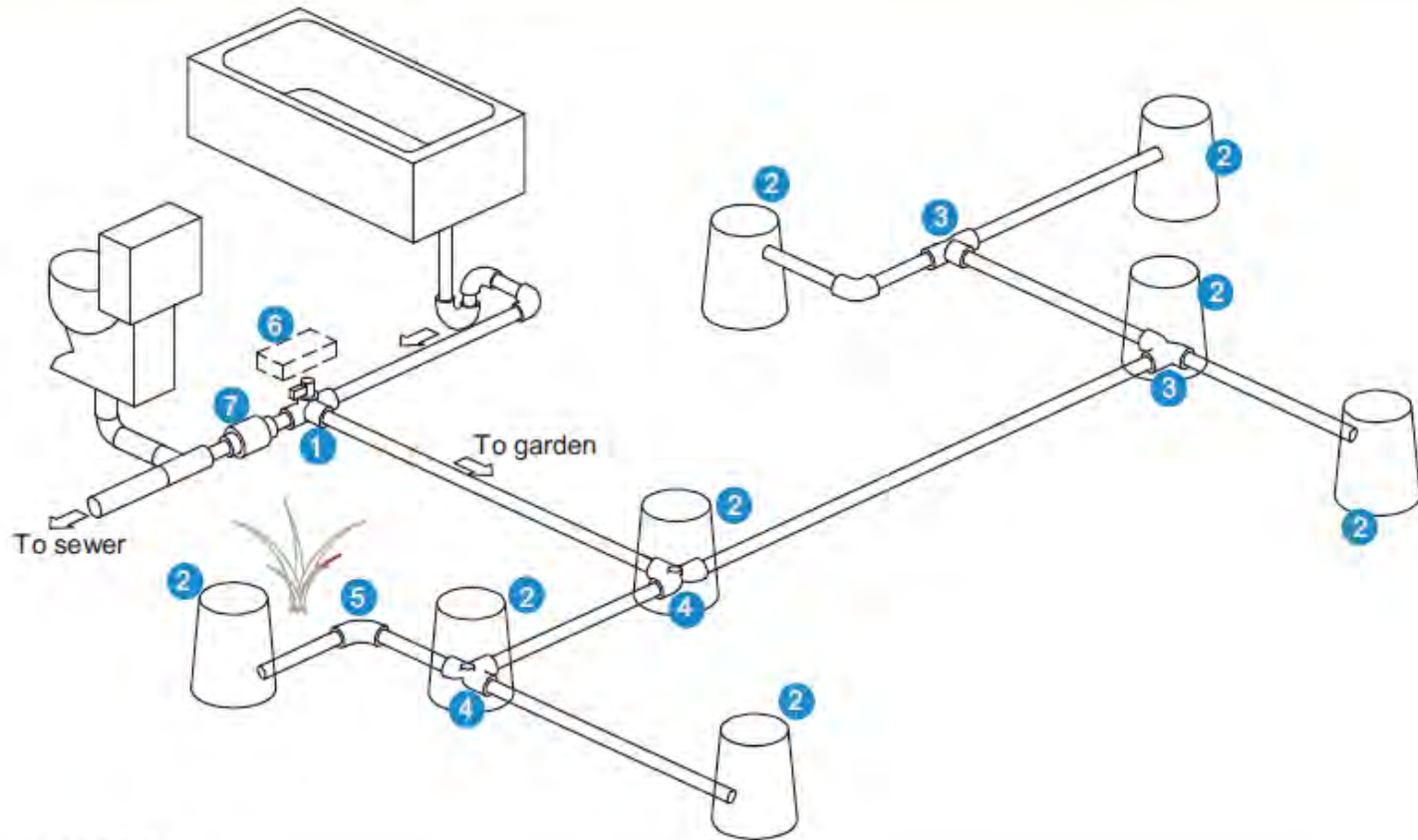
1. 3-way diverter valve
2. 7" round valve box or rigid 3" gallon pot
3. ABS 1.5" or 2" double ell (aka twin 90)
4. ABS 1.5" or 2" double ell (aka twin 90) w/ inspection/clean-out port (optional)
5. 1.5" or 2" long sweep 90° bend
6. Optional 3-way valve actuator
7. Backwater valve

# Tools for Branched Drain

## **Below are some tools that may be helpful for a Branched Drain installation:**

- Measuring tape
- Stud finder
- PVC cutting tools (ratcheting cutters, saw, tubing cutters)
- 2 pairs of channel locks
- Torpedo level
- Drill (1.5" hole saw, 1/4" pilot bit,)
- Screwdriver
- Hammer
- Tin snips
- Caulking gun
- Digging tools (Shovel, pick axe)
- Wheel barrow
- Permanent marker
- Gloves and rags
- Leveling tools (4' level, laser level)
- ABS cutting tools (ABS saw, reciprocating saw or sawzall with appropriate blades)
- 2 1/8 " hole saw

# Branched Drain System



## Legend

- |   |                                  |
|---|----------------------------------|
| 1 3-way diverter valve  | 5 1.5" or 2" long sweep 90° bend |
| 2 7" round valve box or rigid 3" gallon pot                             | 6 Optional 3-way valve actuator  |
| 3 ABS 1.5" or 2" double ell (aka twin 90)                               | 7 Backwater valve                |
| 4 ABS 1.5" or 2" double ell (aka twin 90) w/ inspection/ clean-out port |                                  |

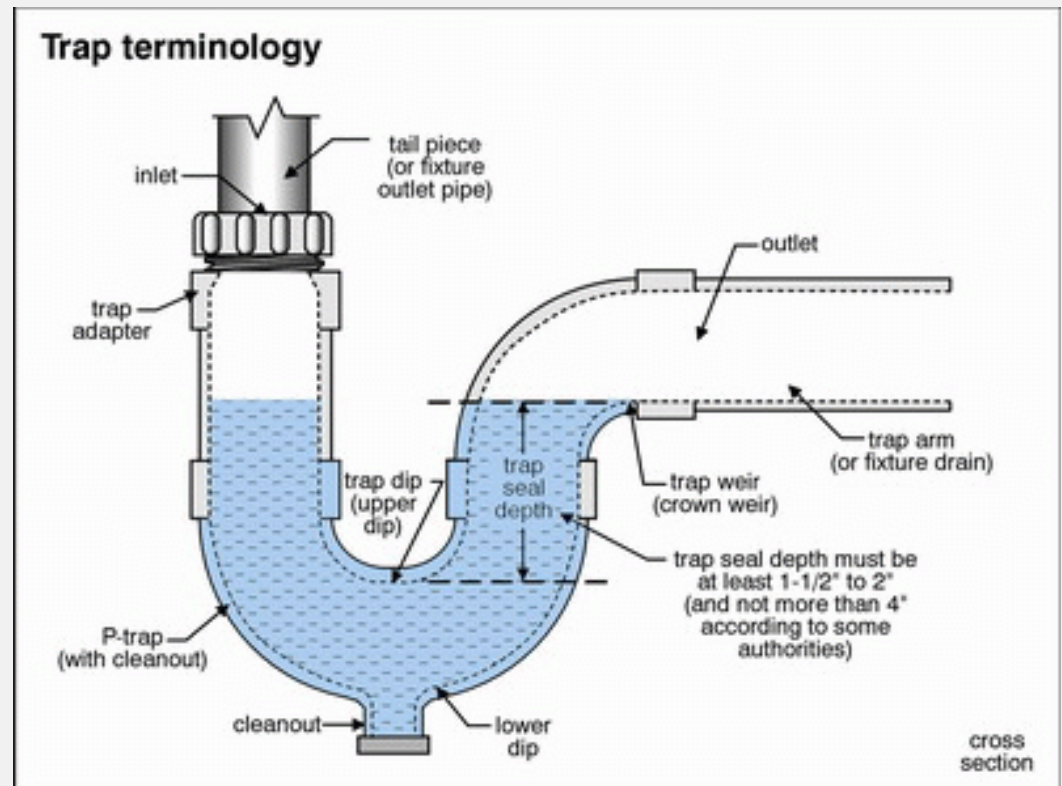
# Step 1: Identifying Pipes; Common Pipe Sizes

**Waste water pipes are sized by the amount of water that travels through them**

**The size refers to the “ID” or “Inner Diameter”**

- Toilets 3” to 4”
- Lavatories (bathroom sink) 1 ¼” or 1 ½”
- Kitchen sinks 1 ½” to 2”
- Showers and tubs 2” (but you may see 1½ or smaller)

**P-Traps prevent sewer gases from entering the building.**



# Step 1: Identifying Pipes; How to ID Correct Graywater Drain

## **1. Check pipe size**

- Larger pipes usually include the toilet water

## **2. Check for a p-trap**

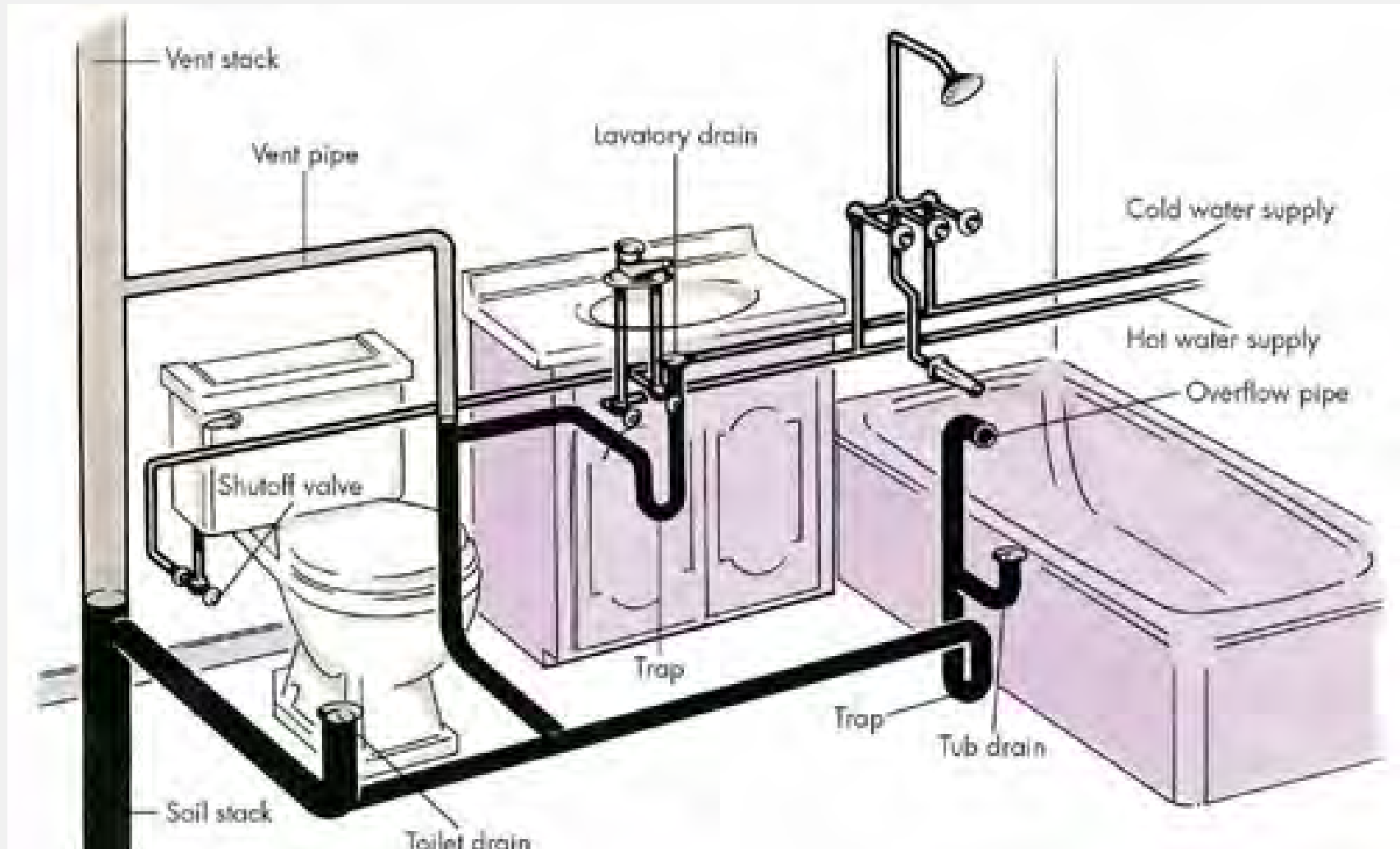
- Visible p-trap is from a shower/bath or maybe laundry
- Kitchen sinks, bathroom sinks, toilets, washer standpipes and laundry sinks have p-traps in the house

## **3. Run HOT water in the drain line**

- If you feel the pipe heat up, then you know what's going into it. If there is any question about the toilet being connected, flush the toilet, feel and listen for water. Second story bathrooms almost always connect the toilet and shower drains in the floor.

**Need help? Partner with a plumber for indoor modifications!**

# Step 1: Identifying Pipes; Common Plumbing for a Second Story



# Step 1: Identifying Pipes; Common Plumbing

## Tub/shower

- Trap under floor
- 1 ½"-2" drain



## Sinks

- Trap below sink
- 1 ¼"- 2" drain
- Vents can be confused for sink drains



## House main sewer lines: oldest to newest

- Clay, Cast Iron, Steel, Plastic (PVC, **ABS**)

**Plumbers can help identify pipes!**

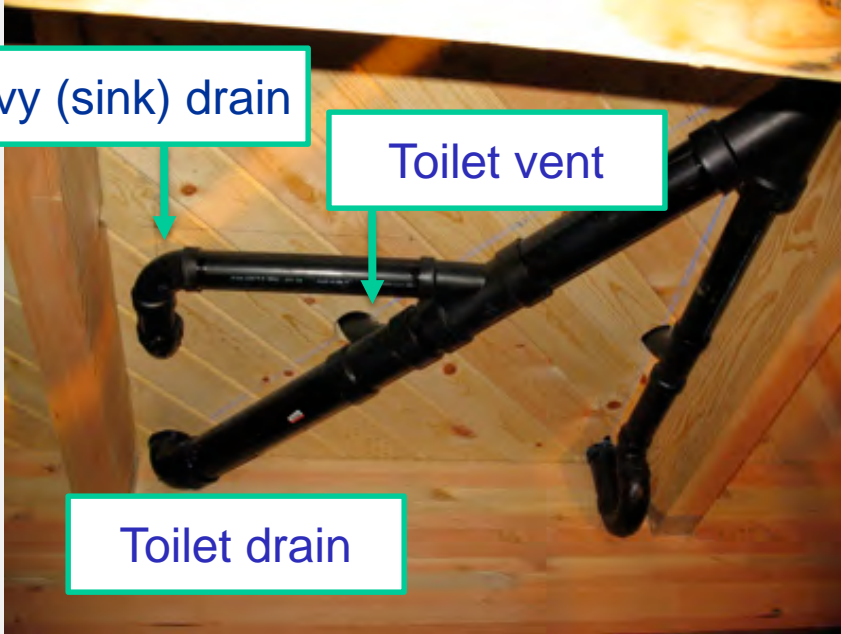
**Most commonly used material**

# Step 1: Identifying Pipes; Common Plumbing

Lavy (sink) drain

Toilet vent

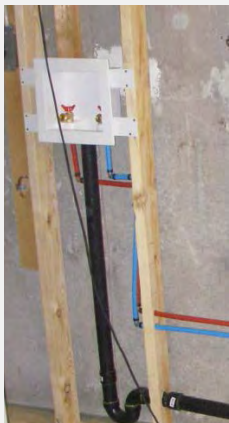
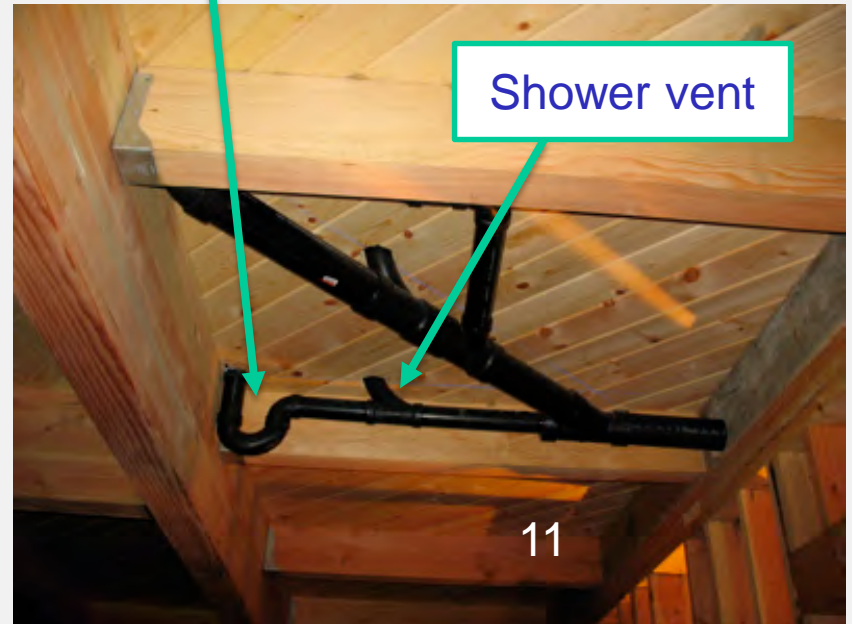
Toilet drain



**If the graywater drain connects to the toilet the water is unusable and against code**

Shower drain/p-trap

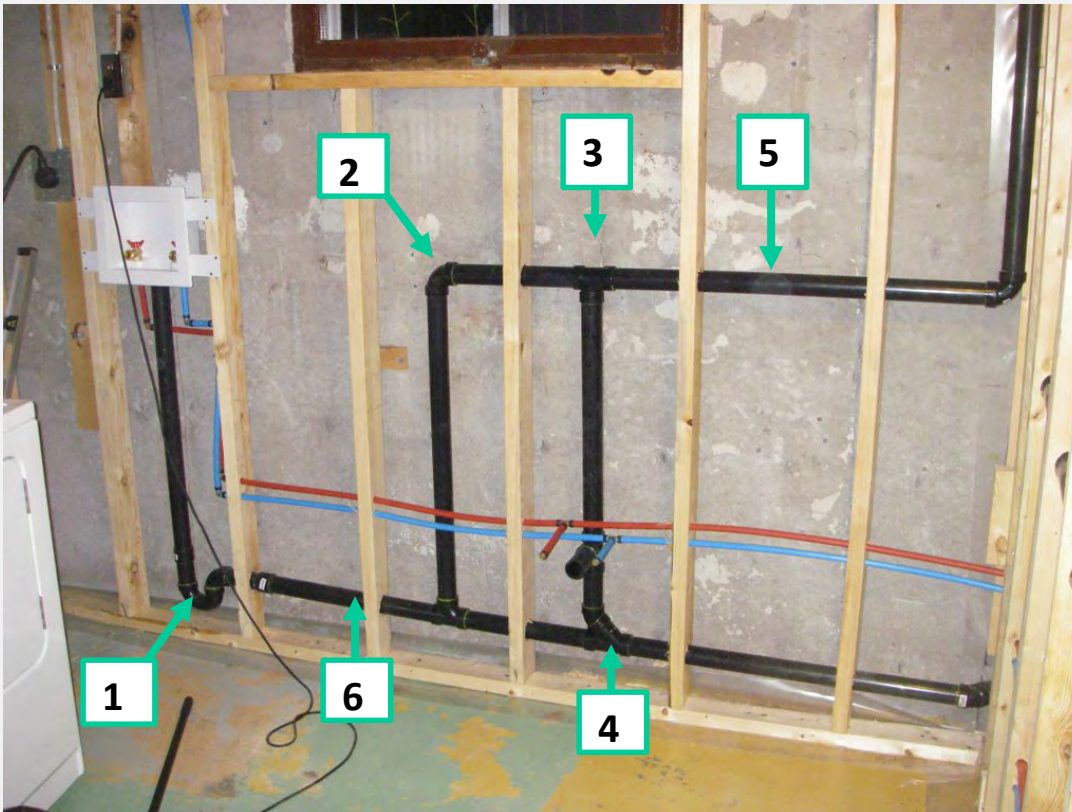
Shower vent



**Laundry p-trap inside wall, no trap visible under floor**

# Activity 1: Identifying Plumbing Images

**Identify the fitting, source of water, and material for the picture on your activity.**



# Step 2: Obtain a permit from Local Permitting Agency

## **Obtain a permit from the authorized permitting agency. Follow permitting procedures and proper inspections.**

- Keep in mind that permitting requirements may need to be integrated in to the timeline and budget of the project.
- Estimated permit cost

	Branched Drain	Pumped System
Range	\$50 - \$550+	\$250 - \$550+
Typical	\$150 - \$250 (33%)	\$550+ (50%)

Source: Greywater Action, Residential Greywater Irrigation Systems in California: An Evaluation of Soil and Water Quality, User Satisfaction, and Installation Costs

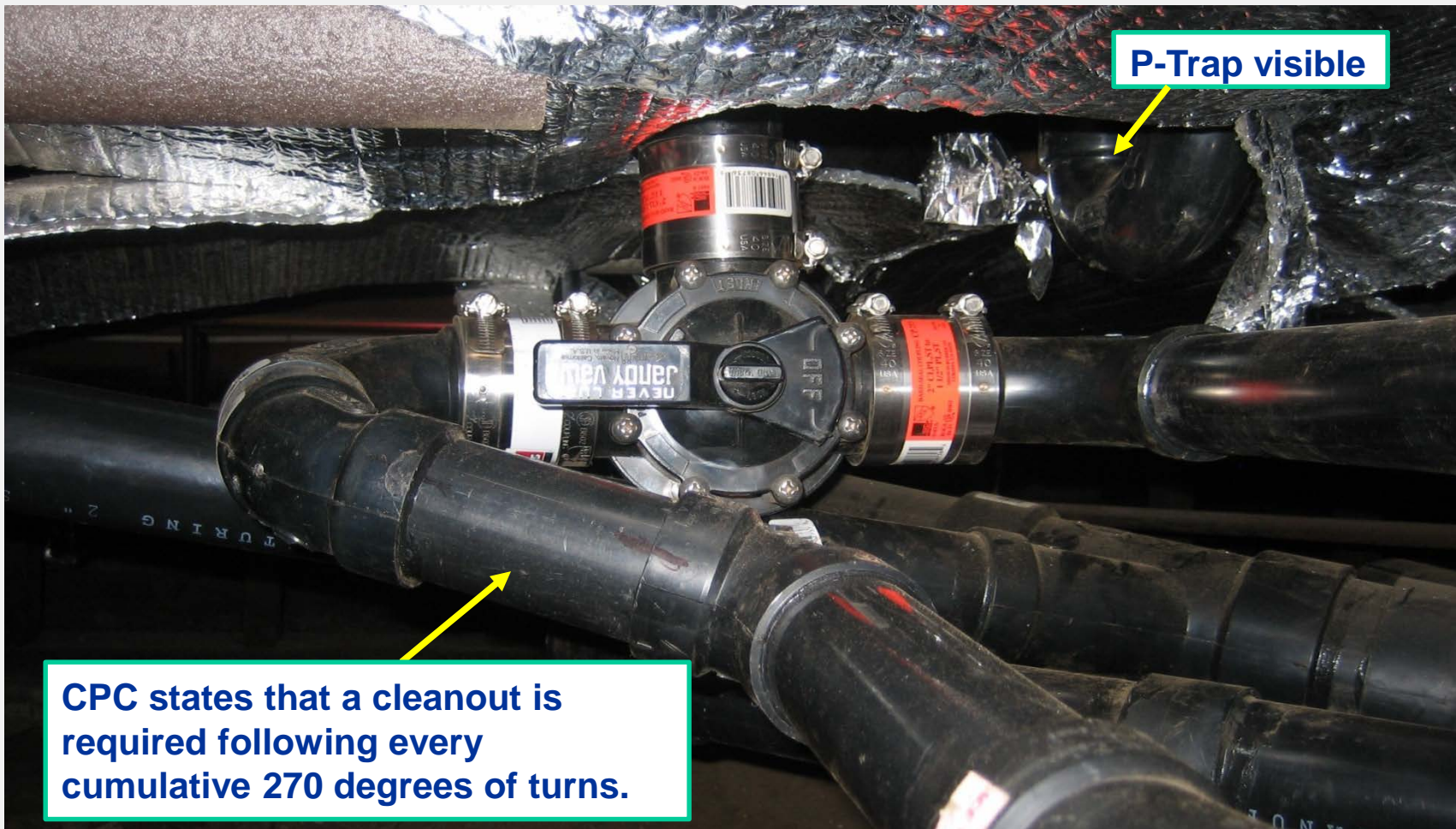
## Step 3: Install a 3-way Diverter Valve

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- Install a 3-way diverter valve in the drainpipe of the fixture you will be collecting graywater from.
- The valve must be installed after the p-trap and vent but before the connection to a toilet or kitchen sink drain.
- If you must install the valve in an inaccessible area because of space considerations you can add a motor called an actuator to operate the valve remotely.

# Where to Install a 3-way Diverter Valve

**Note: Valve should be clearly marked and easily accessible.**



# Step 3: Install a 3-way Diverter Valve



**1 ½" ABS glued into 3-way valve**



**All sides 2" ABS**

# Testing your 3-way valve

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## **Inside:**

- Wait for glue to dry
- Run water and check for leaks

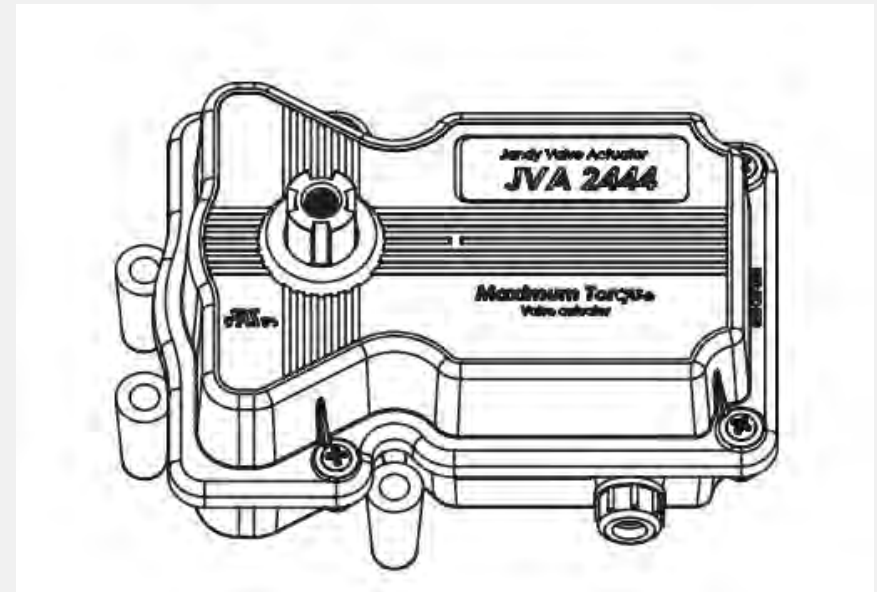
# Step 4: Installing an Actuator

**If the 3-way valve is difficult to access you will need to install an actuator to operate the 3-way valve remotely.**

**An actuator is an electrically powered motor that turns the 3-way valve**

## **Used when**

- 3-way valve is not easily accessible (e.g. tiny crawl space)
- Frequent turning of the valve is necessary



# Activity 2: Wiring an Actuator

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As you go through the following slides watch your instructor demonstrate how an actuator is wired.

Follow along on your diagram.

## Step 4: Installing an Actuator; Common Brands

**Kits are available containing a transformer, fuse, switch, and plastic box**

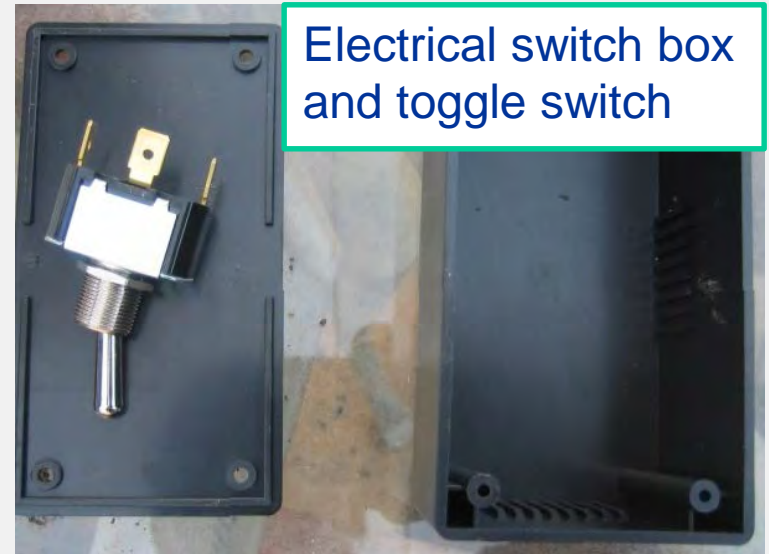
- Jandy Valve Actuator (\$120-\$200)
- Goldline Valve Actuator (\$90-\$120)
- Pentair Valve Actuator(\$120-\$160)
- Intermatic Valve Actuator (\$60- \$120)

# Step 4: Installing an Actuator; Parts of an Actuator

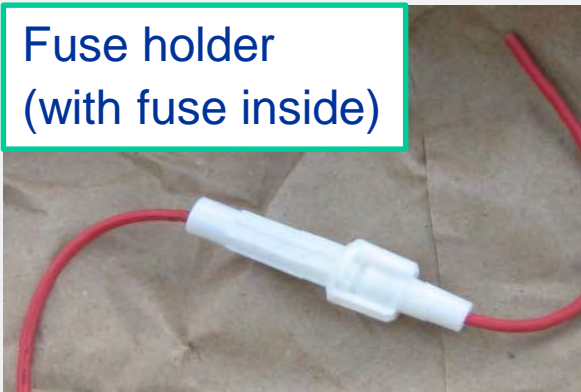
Actuator



Electrical switch box  
and toggle switch



Fuse holder  
(with fuse inside)



Transformer



Use 18 gauge wire  
if you need more wire

# Step 4: Installing an Actuator

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- a) Check cam settings for proper orientation of the actuator on the three way valve
- b) Mount actuator on 3-way valve
- c) Install transformer and wire to electrical switch box
- d) Mount electrical switch box
- e) Tuck in wires, close box, plug in transformer
- f) Test the actuator
- g) Troubleshooting: Follow manufacturer instructions to calibrate the actuator (if necessary)

# Step 4 a) Cam Settings for Valve Orientation

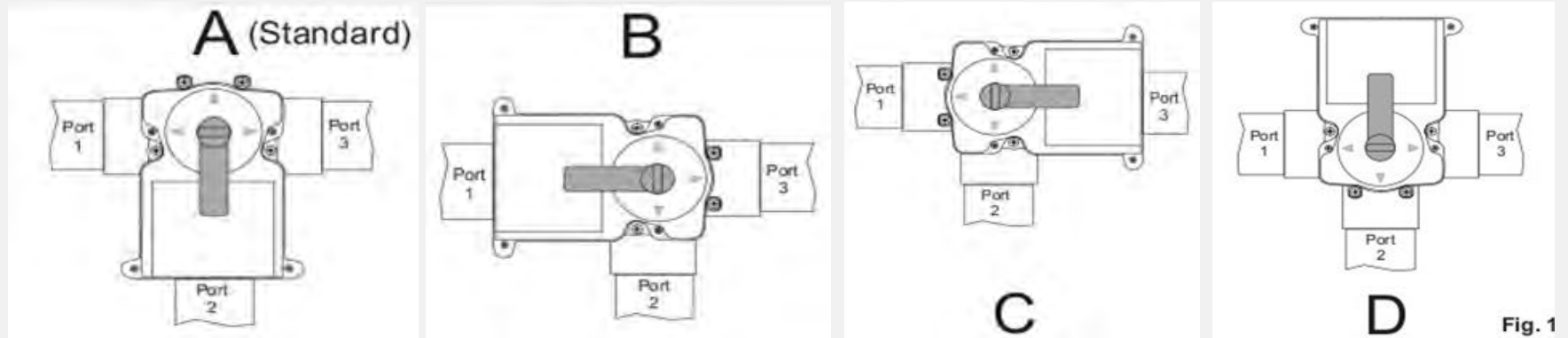


Fig. 1

GVA MOUNTING OPTION	PORT WHERE WATER ENTERS	CAM SETTING		PORT WHERE WATER EXITS	
		LOWER CAM	UPPER CAM	PORT	PORT
<b>A</b> (Standard)	1	6 o'clock	9 o'clock	2	3
	2 (std)	12 o'clock	12 o'clock	1	3
	3	3 o'clock	6 o'clock	1	2
<b>B</b>	1	9 o'clock	12 o'clock	2	3
	2	3 o'clock	3 o'clock	1	3
	3	6 o'clock	9 o'clock	1	2
<b>C</b>	1	3 o'clock	6 o'clock	2	3
	2	9 o'clock	9 o'clock	1	3
	3	12 o'clock	3 o'clock	1	2
<b>D</b>	1	12 o'clock	3 o'clock	2	3
	2	6 o'clock	6 o'clock	1	3
	3	9 o'clock	12 o'clock	1	2

- Most Actuators can be mounted to the valve in four different positions.
- The cam setting determines which port the water will be entering from and which port it will leave from.
- Refer to your user manual to determine the appropriate cam setting for your needs.

Goldline Installation Manual; Model GVA-24

# Step 4 b) Mounting the Actuator



- a. Remove handle and the 4 screws on the 3-way valve
- b. Attach actuator by replacing the short screws with the longer screws provided by the manufacturer
- c. Replace handle (manual operation)



# Step 4 c) Wire Actuator to Electrical Switch Box

- a. Determine best location for switch (near an outlet)
  - i. Actuator switches can be located inside a sink cabinet, or attached to any wall
- b. Run the wire from the actuator to the location of the switch box
- c. Wire according to the manufacturers instructions for your actuator
- d. Drill holes only if necessary



## Step 4 d) Mount Electrical Switch Box

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**In the location selected mount the switchbox using the screws provided with the actuator kit**

# Step 4 e) Tuck in Wires, Close Box, Plug in Transformer



# Step 4 f) Test the Actuator

## **Verify actuator operates the 3-way valve properly**

- Turn toggle switch "up". Observe what happens with the actuator.
- Turn toggle switch "down". Observe what happens with the actuator.

**Once it's working label the toggle switch (eg. "up" = sewer")**

## Step 4 g) Troubleshooting

**If it doesn't you'll need to open it and adjust the pins using the manufacturers' guide.**

### **Example troubleshooting:**

If the 3-way valve's inlet port was changed, you'll need to calibrate the actuator

- Test to see how the actuator is rotating, open actuator and observe inside
- Adjust actuator's rotation using manufacturers guide

# Step 4 g) Maintenance and Warranty

- Two seals that need annual lubrication
- 1-3 year warranty for residential homes, depending on the brand
- Follow recommendations for your specific valve

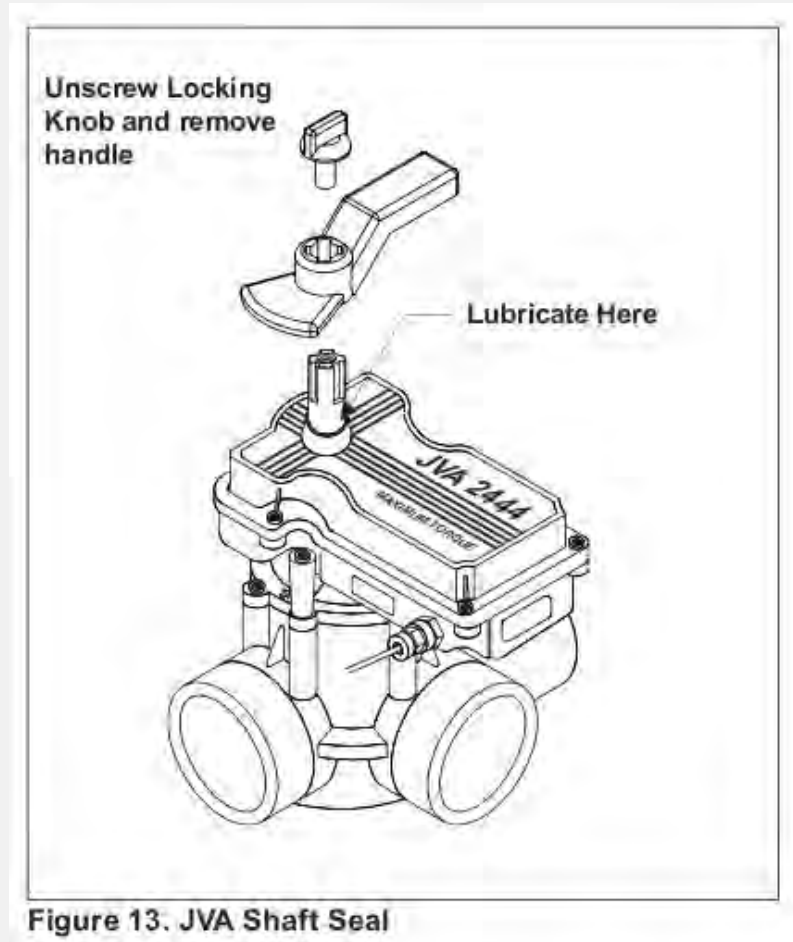


Image from Jandy Valve Actuator I&O Manual

# Branched Drain Outside Portion

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Step 5: Branched Drain design

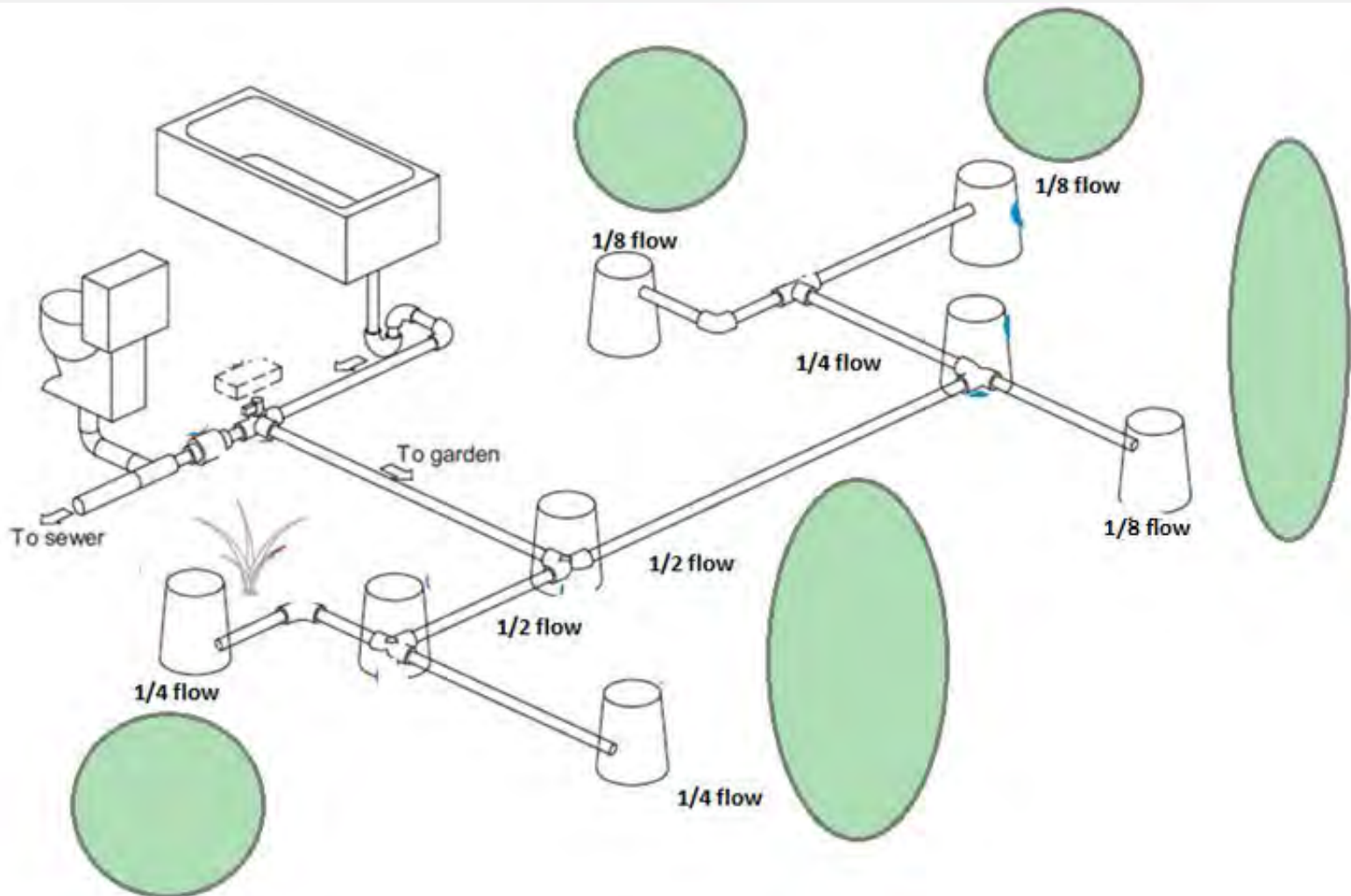
Step 6: Piping to irrigation field

Step 7: Calculate and dig mulch basins, build mulch shields

Step 8: Lay pipes to mulch basins

Step 9: Installing Double Ells

# Step 5: Branched Drain Design



# Step 5: Branched Drain Design

**Irrigate larger plants (trees, shrubs, perennials)**

**Pipe size will depend on indoor plumbing (typically 2-inch)**

- **Pipe size can be reduced at double ells**

**Each split divides flow in half if level**

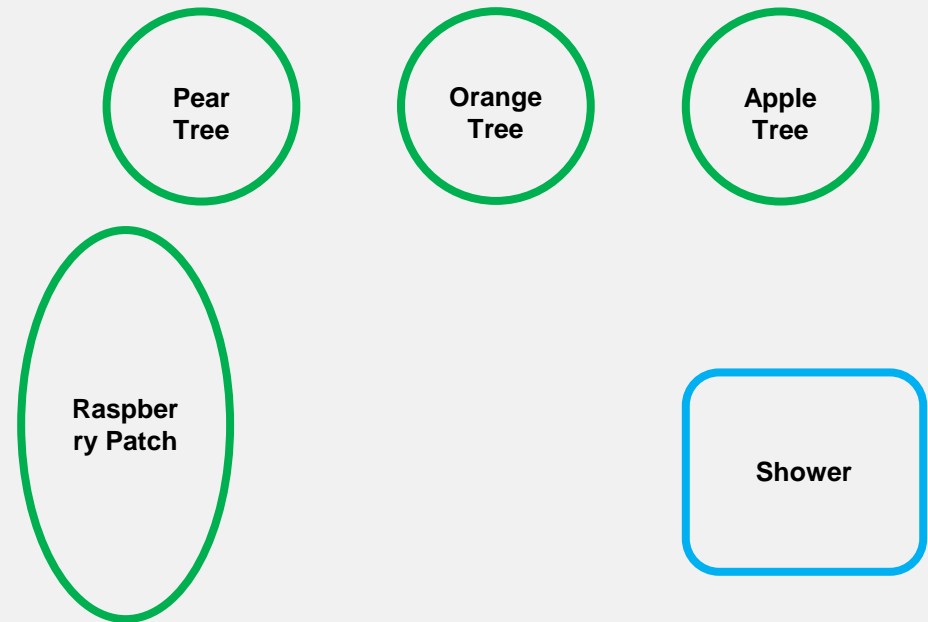
- **To ensure an even split have a 2' straight section of pipe before splitter. If pipe enters splitter at an angle the water won't divide evenly.**

**Plan your branched drain system so the pipes will always have a 2% slope**

**Consider obstructions (pipes, roots, etc.) that can make the installation more challenging**

# Activity 3: Branched Drain System Design

- The yard is flat.
- Sketch how you could split up the graywater and pipe between the plants.
- Try and be accurate with the turning options (90, 45, 60, 22 degree bends), and list the ABS drainage fittings you used.
- Use the least amount of materials possible.
- Complete only the outside portion of the system.



# Activity 3: Branched Drain System Design

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# Step 5: Branched Drain Design

## Creating zones with a 3-way valve

A 3-way diverter Valve can be used to create two graywater "zones"

Zones irrigate different areas of the yard. This house is dual plumbed, so both shower and laundry go into the system



# Step 6: Piping to Irrigation Field

- You may have to pipe around decks, patios, etc.
- You may need to bypass hardscape
  - Options: go under it, go around it, remove it, cut a strip of it, cut across the driveway and patch in
- Maintain a downwards slope
- Paint exposed PVC pipe to protect from UV
- Caulk holes at building exit points



# Step 7: Mulch Basins

**Refer to Class 3 and Table 1602.10, for information on sizing the irrigation area and class 5 for information on mulch shields**

**Plan for mature plant size**

Type of Soil	Minimum sqft of irrigation area per 100 gallons of graywater/day	Max absorption capacity (gallon/sqft/day)
Coarse sand or gravel	20	5.0
Fine Sand	25	4.0
Sandy Loam	40	2.5
Sandy Clay	60	1.7
Clay w/ considerable sand or gravel	90	1.1
Clay w/small amounts of sand or gravel	120	0.8

# Step 8: Lay pipes to Mulch Basins; Slope

## Slope

**A downward fall is needed to keep the water moving!**

- Install pipes at 2% grade downhill or 1/4 inch per foot
- Maintain flow and help solids move through pipe

Positive slope = Ideal



Excessive slope = Not ideal



No slope = Not ideal



Negative slope = Not acceptable



# Step 8: Lay pipes from Diversion Point to Mulch Basins; Slope

## Slope

- All parts of system need proper slope
- More slope when flow is downhill is okay
- Level pipes at splitters are required
- If level put 1" block on 4' level to get 2% slope



# Step 9: Double Ells

## Double Ells are also called Flow Splitters

- Each split divides flow in half
- Flow Splitters must be level
- Pack soil under pipe, then stake or bury points along line to keep grade
- Check that all Double Ells are level across the split



# Step 9: Double Ells

## Double Ells are multifunctional as cleanouts

Create an access point by putting a container around the double ell so it will be accessible for maintenance

### 1" PVC threaded plug

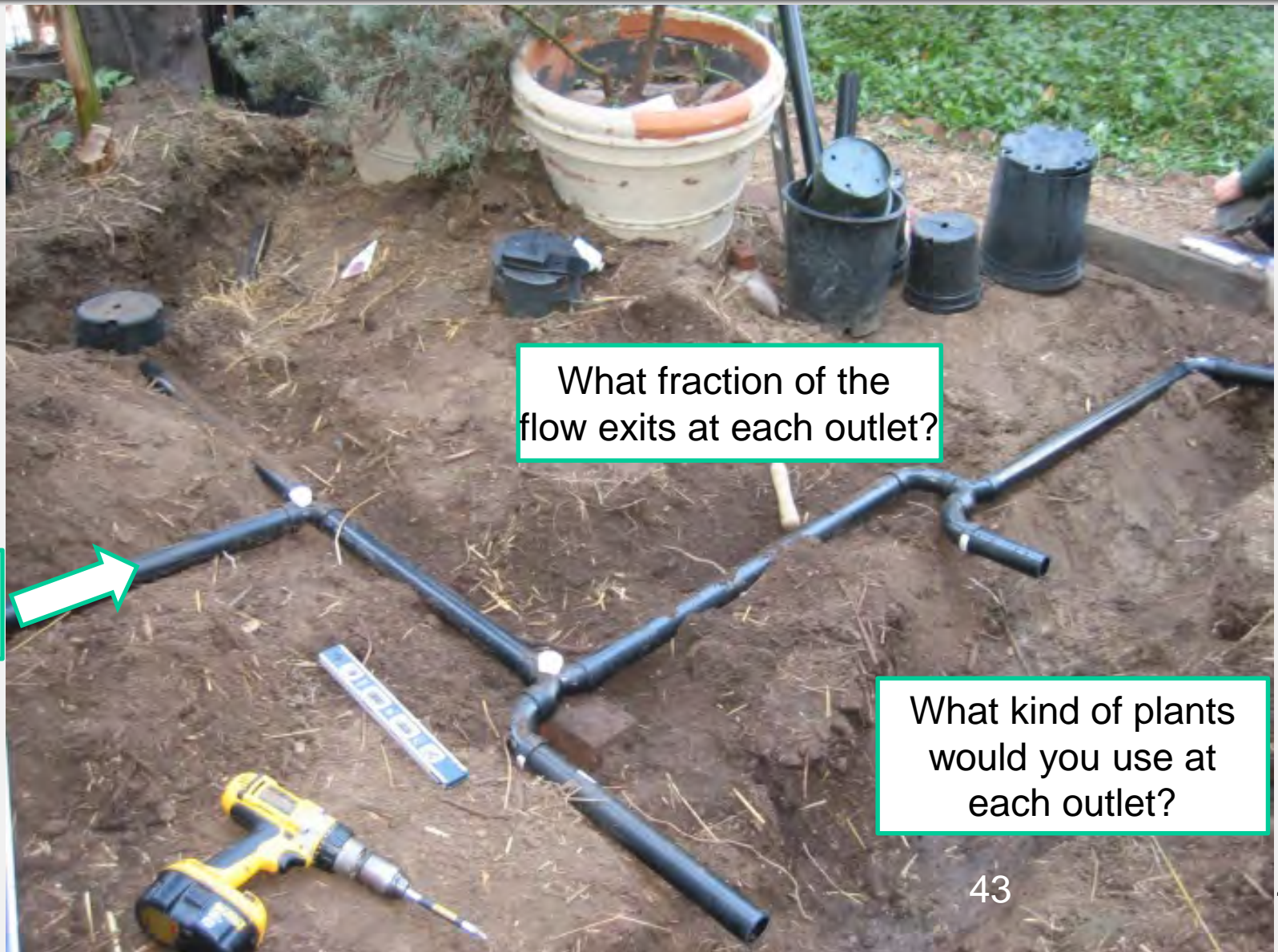
- Threaded plug
- Install cleanouts before burying

### Drilled double-ells cleanout

- Drill hole
- Thread 1" plastic cap



# Activity 4: Plant Placement and Flow Distribution



What fraction of the flow exits at each outlet?

Water In

What kind of plants would you use at each outlet?

# Follow up

- Final Inspection for Permit
- Check for leaks
- Take a picture before burying pipes to include in O&M manual
- Label pipes every 5 feet “CAUTION: NONPOTABLE GRAY WATER, DO NOT DRINK”
- Best case scenario: pipes are bedded in sand with metal detectable tape over line
- Bury pipes
- Caulk holes
- Post signs
- Post O&M manual